JAN 15 1936

AGRICULTURAL NEWS LETTER

VOL. 4 - NO. 1 JANUARY 1936

THIS PUBLICATION GIVES INFORMATION on new developments of interest to agriculture based on the work done by scientists and agricultural field men of the du Pont Company and its subsidiary companies.

It also gives reports of results obtained with products developed by these companies in the field whether the tests are made by field men of the companies, by agricultural experiment stations or other bodies. Also data on certain work done by agricultural stations on their own account and other matters of interest in the agricultural field.

This issue contains:

Cotton Stands and Yields in Southwest Increased by Seed Disinfection with Certain Chemical Dusts.

Improved Chemical Wood Preservation from Use of Chromated Zinc Chloride.

Florida Experiment Station Finds Use for Waste from Citrus Canning Plants.

A Brief Outline of Chemical Achievements Ensuing from du Pont Research Activities.

An Effective and Economical Method of Blasting Stumps in Drained Marshes to Clear Land for Use.

Issued by
Publicity Department,
E. I. du Pont de Nemours & Co.,
Wilmington, Del.

Printed in U.S.A.

COTTON STANDS AND YIELDS IN SOUTHWEST INCREASED BY SEED DISINFECTION WITH CERTAIN CHEMICAL DUSTS.

EDITOR'S NOTE:- While seed treatment to protect plants from disease is not as universally practiced as is the use of fertilizer to promote plant growth, the disinfection of seed is steadily gaining in acceptance as a standard practice. This paper is a helpful contribution to a better understanding of the value of treating cotton seed.

By H. C. Bucha, Plant Pathologist,
Research Dept., Bayer-Semesan Co.,
Wilmington, Delaware.

In the December, 1934 issue of the Agricultural News Letter was published an account of the results obtained by the use of chemical dusts for cotton seed treatment on 16 Texas farms. In 1935 additional tests of the same type were conducted on farms in four southwestern cotton states including Texas, Oklahoma, Louisiana, and Arkansas. Six counties were represented in 18 tests.

All tests were located in regular commercial plantings and were planted at the same rate of seeding and with the same planter used by the grower. To make the comparisons as accurate as possible treated and untreated seed were planted in alternate rows on each of the 18 farms, each test occupying from one-half to one and one-half acres of land. Before chopping out, a count of the stand was made, which showed that in practically every case the treated rows had a decidedly better stand of plants than the untreated rows. As in 1934, in most cases the increase in stand as a result of seed treatment was at least 25 percent and in a few tests it was from 100 to 200 percent. The average increase in stand for the 18 tests was nearly 57%. By direct comparison this means that for every 100 plants in the untreated rows there were about 157 plants in the treated rows. This made it possible, even after chopping, to leave a much more uniform stand of the stronger plants in the treated rows.

Results of Treatment

After chopping out, or rather at picking time, another count of the plants was made. It was found that the treated rows had about 35 per cent more plants than did the untreated rows. Thus for every 100 plants in the untreated rows, there were about 135 plants in the treated rows. From these figures, one would expect an increased yield for the treated rows since this "picking-time" count represented largely the plants which had yielded seed-cotton.

Continued on next page

Naturally, of greatest interest to the cotton planters was the effect of the seed treatments on the yield. In some cases the yields were below normal because of lack of sufficient moisture, while in other tests the yields were normal or above. However, in every case but one, the treated rows outyielded the untreated by 24 to 536 pounds of seed cotton per acre, the average increase was 135 pounds or nearly 19%.

With these figures, obtained with the direct cooperation of the planter, it was not hard to prove that seed treatment paid big dividends considering the small cost of 9 to 14 cents per acre for material.

Value of Treatment Recognized

The practice of treating seed cotton before planting is rapidly becoming a regular operation on many large plantations and has been used by cotton seed breeders for the past six years. The advantages of cotton seed treatment, in the control of certain seed-borne diseases as well as in its aid in protecting seed and seedlings from rotting under early season cold, wet conditions, have been described by the Agricultural Experiment Stations in the South for several years. The information obtained by these tests in 1935 adds to our knowledge of, and experience with, seed treatment under a wider range of territory and other sets of climatic conditions.

IMPROVED CHEMICAL WOOD PRESERVATION FROM USE OF CHROMATED ZINC CHLORIDE

EDITOR'S NOTE:- The importance of wood preservation in rural districts is generally recognized. Therefore, the reprinting, in part, here of a discussion which appears in The Du Pont Magazine seems timely.

By E. H. Rieman,
Grasselli Chemical Co.,
Cleveland, Ohio.

A discussion of the benefits accredited to chemical wood preservation is incomplete without acknowledgment to the railroads and to the U. S. Forest Products Laboratory for the impetus given this resourceful industry. Foresight impelled by safety and economic necessity caused them to recognize the need and utility of wood preservation decades ago and patiently and cooperatively to lend their efforts toward its continued improvement.

Wood is usually accepted as an article of commerce available in perpetuity--an assumption not literally true. Despite the practice of preservation and reforestation, our national timber requirements are already in excess of replacements, meanwhile existing forests of the naturally durable virgin species are rapidly becoming depleted, and second-growth or substitute material is encroaching in its field. Statistics show that the present widespread use of preservatives by the railroads and utilities has already averted complete exhaustion of our domestic timber supply.

Decay in wood is caused by living organisms known as fungi, low parasitic forms of plant life. These spores, when lodged in crevices of wood, under favorable conditions, germinate rapidly, emitting destructive filaments that ultimately penetrate wood throughout its entire structure. For growth and propagation rot-producing fungi require air, favorable temperatures and food which consists of the cellulose or wood fiber and moisture. Removal of any of these requirements inhibits fungous development and establishes immunity to decay. Conditions affecting air, temperature or moisture are difficult to control, but complete impregnation of the wood fiber with suitable chemicals which are toxic to complex growths of fungi renders the cellulose unfit as food and makes further attack uninviting.

Chemical wood preservation stands out as an industry built upon authentic service records and basic facts. From new theories to

Continued on next page

highly developed practice, progress has been marked by a conservative recognition of actual accomplishment. During this transition period innumerable treating reagents have been sponsored. Many were found to be of little value in service. Others involved high initial cost, difficulty of application, or the use of constituents harmful to the human system.

General Specifications

It is axiomatic that a good wood preservative must possess several inter-related properties including high initial toxicity to wood-destroying fungi, physical permanence of the preservative in the wood, and retention of toxicity by the preserving material.

As compatible measures, the treating reagent must not reduce the strength or depreciate the physical characteristics of the treated wood; and it must not contain ingredients capable of causing contamination or contribute health hazards to those subject to its exposure. It must also be economical and, of course, readily available without limiting restrictions to the entire wood-treating industry.

Preservatives in Commercial Use

Of the many wood-preserving reagents sponsored from time to time, only the zinc chloride formulations and coal-tar creosote oil have gained extended use. Their efficacy and subsequent acceptance are predicated entirely upon service records embracing periods of time which actually antedate the compilation of such records. In deference to this performance they have become the only established "standard" reagents of the American Wood Preservers' Association, the American Railway Engineers' Association and other leading organizations of this character. Standard specifications and methods of recommended practice govern their use. The zinc chloride formulations and creosote oil both command their sphere of usefulness. In trade parlance, zinc chloride is known as a "white" treatment and is preferred where paintability or fire repellence is necessary and where the color or odor of creosote oil is objectionable.

The toxicity of zinc chloride to wood-destroying fungi was recognized nearly a century ago. Extended use in this country began with domestic production by The Grasselli Chemical Company nearly fifty years ago. It would be difficult to estimate the total volume of wood treated with zinc chloride since then, but statistics compiled for the past seven years reveal a total of 184,000,000 cubic feet --the equivalent of 2,200,000,000 b.m.f.--of "salt"-treated lumber and timber. Of this production, approximately ninety-three per cent represented zinc chloride impregnation.

Continued on next page

An Improved Product

While past performance is pleasant enough to review, progress demands a constant search for improvement. Grasselli engineers in collaboration with the wood-treating industry undertook a broad, unbiased study of all outstanding commodities said to possess preservative value. They included both organic and inorganic compounds, irrespective of their origin. Each was evaluated by itself and in compatible formulations with a view toward developing a fundamentally sound new reagent or amplifying the existing properties of known commodities. From this extended research, a distinctly superior non-proprietary reagent has been developed, the first major improvement to commercial zinc chloride. This formulation, which is basically zinc chloride, retains the attributes of its predecessor and is now identified as Grasselli Chromated Zinc Chloride.

It consists of commercial zinc chloride meeting A.W.P.A. specifications and sodium dichromate of an approved quality. Both are combined in a manner peculiar to their individual properties. The initial toxicities of these components have long been established by the Forest Products Laboratory and require no comment. In a combined state this formulation is exhibiting a preservative value relationship that compares favorably with heavy retentions of creosote oil and is far better then unaltered zinc chloride which ranks next in order. The physical permanence of the preservative and its retention of toxicity are substantiated by laboratory exposures of leached specimens and by actual outdoor service tests. Detailed data concerning these exposures will be gladly supplied upon request.

Some Advantages

From an operating standpoint, chromated zinc chloride may be used interchangeably with unaltered zinc chloride. Any plant that is equipped to render "vacuum-pressure" impregnation can employ this reagent.

Chromated zinc chloride is free from arsenicals, mercuricals, fluorides, phenolic compounds and other toxic volatile organic chemicals capable of imposing health hazards on those who treat or handle the wood or on those who are exposed to the finished product. Consequently, wood so treated may safely be used in buildings intended for human habitation or in those designed for the storage of foodstuffs.

FLORIDA EXPERIMENT STATION FINDS USE FOR WASTE FROM CITRUS CANNING PLANTS

EDITOR'S NOTE:- Typical of the achievements of agricultural experiment stations which are beneficial to industry as well as agriculture is the development of the use of canning plant waste as a valuable constituent of cattle feed. This accomplishment is to the credit of the University of Florida Agricultural Experiment Station, Gainesville, Florida. Dr. Wilmon Newell is the director.

At one time cotton seed were dumped into the Mississippi and other rivers to get them out of the way. Today they often represent the profit on the cotton crop. Other instances of the utilization of waste products are numerous, and in some cases profitable industries have been built entirely on goods formerly not utilized and sometimes even disposed of at considerable expense.

Industrialists and farmers now realize that in proportion as practically all parts of a farm product can be commercially utilized, the output is likely to prove profitable. Florida citrus fruits in this respect are not essentially different from other crops.

Recognition of this fact has long existed among growers and shippers. Canneries and by-product factories have been developed that more of the oranges and grapefruit might go into consumption. While these plants have absorbed much of the lower grade and surplus output, they take by no means all of it. Further, their operations in themselves create a vast volume of waste.

Surveys have disclosed that between 65 and 75 percent of the grapefruit processed by canners remained as refuse and was discarded. Waste at the canning establishment of Florida, in the five year period which began with the 1929-30 season and ended with 1933-34, averaged 64,642 tons annually.

Investigations Reveal Use

Avenues for the profitable utilization of grapefruit cannery waste have been sought by the Florida Agricultural Experiment Station with a considerable degree of success. Investigations concerning the feasibility of converting the refuse into feed for livestock have revealed promising possibilities along that line. Feeding tests with the material gave excellent results.

Continued on next page

Jersey cows in the Experiment Station herds learned to eat the product of their own volition, in from one to six days, when it was offered to them after they had finished with the rations fed daily. Steers accepted the feedstuff freely from the beginning of the time when it was supplied.

Digestibility of the feed was demonstrated in other experiments. Since few products can be used as the sole diet of animals, in these studies the cannery refuse was combined with cut No. 1 alfalfa hay and cottonseed meal, and fed dry.

Cattle consuming the mixture in large proportions soon took on a sleek, oily appearance, indicating thriftiness. A moderately laxative effect of the new feed also was observed in checking up on the animals.

Processing the Waste

Grapefruit cannery waste used in the feeding tests included the peel, the rag and a few seeds. Moisture content had been reduced to eight or ten percent from more than eighty.

Processes have been patented which dry the refuse by means of pressing and exposure to heat. After bagging, it stands for a short time in air-dry warehouses.

In the dried form, as fed at the Station, the cannery leavings constitute a concentrate, high in digestible carbohydrates and low in protein. Use is suggested as a substitute for part of the corn feed meal furnished to animals. The place of dry beet pulp also might be taken.

Research on the subject covering other aspects still is under way at the State Agricultural Experiment Station, in Gainesville.

When all parts of this state's citrus fruits are utilized, growers will find their groves more profitable than at present. In effort to that end the Experiment Station is supplementing its service bearing on fruit production.

A BRIEF OUTLINE OF CHEMICAL ACHIEVEMENTS ENSUING FROM DU PONT RESEARCH ACTIVITIES

EDITOR'S NOTE:- There are presented here portions of an article which appeared in The Herald, Miami, Florida. While necessarily incomplete, the facts given will serve to give an idea of the importance of the manufactures of the du Pont Company. In the production of various things, many of which are not even listed here, the plants of this corporation draw on products of the soil as basic raw stuffs. In that respect, there is offered an example of the capacity of the "factory stomach" to consume products of farm and forest.

E. I. du Pont de Nemours & Co., founded in 1802, has become one of the most important manufacturers of diversified chemical products. This industry, comparatively new in the United States, already produces materials that have greatly changed the course of many manufacturing processes. In some cases it has produced entirely new and revolutionary products.

One of the important lines of activity of the du Pont Company is the manufacture of peace-time explosives, used for commercial purposes.

Powder for Pioneers

The du Pont Company began its existence in 1802, when E. I. du Pont de Nemours, a young Frenchman, established a powder mill on the banks of Brandywine creek, near Wilmington, Del. Sporting powder was the first and for years the only product of the du Pont manufactory. Later, the production of black blasting powder was begun.

From the beginning the company supplied rifle powder for the pioneers, whose food supply depended in great measure on the taking of wild game. Then followed the supplying of powder for the blasting of rock, the clearing of roads, mining and for other enterprises essential to the development of the physical resources of the young nation.

It has continued its commercial activities through all the years, though it has been compelled at times to meet the needs of the nation for powder in times of emergency. But these war-time activities altogether have occupied a comparatively brief period in the company's long life. Its more important, though less spectacular work, has been its contributions to the economic welfare of the country.

Continued on next page

Chemical Progress

At the time of the founding of the du Pont business, industrial chemistry was in its swaddling clothes stage. For instance, the making of gunpowder, though a chemical process, consisted of the mixing in proper proportions of saltpeter, sulphur and charcoal, and reducing the mass to granular form. In striking contrast stands a modern achievement of the company's scientific research in the production of "Du Prene", a synthetic rubber from coal, limestone, salt and water.

Diversity of Products

Another product of the company in world-wide use is "Duco", an automobile finish, which has reduced the time required for finishing an automobile from six weeks to two days. The company developed vulcanization accelerators, chemical compounds which when used in rubber reduce the period of vulcanization to minutes from hours.

Still another product is tetra ethyl lead, the most widely used anti-knock; while the textile industry consumes a large volume of dyestuffs made by du Pont. These dyestuffs cover a wide range and include dyes for all the natural fibers and such man-made fibers as rayon and cellulose acetate rayon. A fungicide for the treatment of newly sawn lumber to prevent sap stain caused by fungi is another product. "Fabrikoid", an impervious fabric with a cotton cloth foundation and a lacquered surface, can be made to simulate in appearance the hide of any animal or the skins of reptiles.

The Grasselli Chemical Company, a subsidiary since 1928, is a smelter of zinc ores and a manufacturer of zinc derivatives.

AN EFFECTIVE AND ECONOMICAL METHOD OF BLASTING STUMPS IN DRAINED MARSHES TO CLEAR LAND FOR USE

EDITOR'S NOTE:- Agricultural engineers are constantly developing new applications of explosives. Characteristic of the progress that is being made is the evolving of a method of removing stumps from drained marsh land which is to be used for farming. An authority on the uses of explosives tells here how to proceed.

By L. F. Livingston, Manager,
Agricultural Extension Section,
E. I. du Pont de Nemours & Company

Low swampy ground grows some of our best crops when the land is drained. But often there are stumps to remove and they are likely to cause a great deal of trouble if blasting by the usual stumping methods is attempted. The reason is that in wet soil the roots of most trees flatten out and lie near the surface. When swampy ground is drained, the water table is usually lowered and the soil of the swamp often settles. This settling has a tendency to pull the earth away from the center portion of the stump, sometimes leaving the stump so high that there is an air space directly under the stump. It has been a common practice to attempt to blast stumps of this sort by locating the hole under the center of the stump and loading it to a considerable depth in an attempt to reach the holding lateral roots. However, in view of the fact that an explosion is a rapid expansion of gases which follows the line of least resistance, it is evident that the gases will be dissipated the instant they are released in the air between the earth and the stump.

It is, of course, possible to shoot the stumps by distributing charges under the heavier roots, but since it does not require a great deal of dynamite to loosen them when loading is done properly, this method is not economical except in the case of the largest of stumps.

An Economical and Effective Method

The best way to blast stumps in a drained marsh is to mud-cap them, as in the case of boulders. Pick out a crevice between two of the larger roots at the base of the stump. If the stump is 18 inches in diameter, use three sticks of dynamite. More is required for larger stumps. Remove the explosive from the wrappers and pack it solidly into the crevice. Prime it with a blasting cap and fuse or an electric blasting cap. Cover the mass of dynamite with

Continued on next page

the cartridge wrappers and then with a minimum of 12 inches of mud. The blast will break the bowl of the stump into several pieces and the large roots will be loosened to a depth that will permit their ready removal with a team or a tractor.

It must be borne in mind that a mud-cap shot is likely to throw small pieces of stump for a considerable distance. Therefore, it is necessary for the blaster to take a distance of at least 300 feet from the stump when it is shot, unless he has some type of barricade to protect him from the front and overhead. Because of greater safety, the electric method of detonating a stump blast is recommended.

#######

INDIVIDUAL EFFORT and accomplishment of outstanding merit in chemical industry has long been recognized by a multiplicity of medals, awards and personal honors. But no comparable recognition of group effort had been made prior to the establishment in 1933 by *Chemical & Metallurgical Engineering* of this Award for Chemical Engineering Achievement. Its primary purpose has been to stimulate a broader participation of chemical engineers in the affairs of industry by honoring that company which, in the opinion of a representative Committee of Award, has contributed most to the advance of chemical industry and of the chemical engineering profession. Of industrial achievements in this field which have come to fruition during the past two years, that of the Organic Chemicals Department of E. I. duPont de Nemours & Co. has been judged the most meritorious. As described in the following article, this is a major accomplishment of which the chemical engineering profession is justly proud.

COMMITTEE OF AWARD

CHARLES E. ADAMS
President, Air Reduction Co.

HARRY A. CURTIS
Chief Chemical Engineer, Tennessee Valley Authority, Vice Pres., American Institute of Chemical Engineers

WALTER A. SCHMIDT
President, Western Precipitation Co., Director, American Chemical Society

ALBERT E. MARSHALL
CHAIRMAN
Consulting Chemical Engineer, President, American Institute of Chemical Engineers

CHARLES BELKNAP
President, Merrimac Chemical Co., Chairman, Executive Committee Manufacturing Chemists' Association

JOHN VAN NOSTRAND DORR
President, The Dorr Company, Inc.

ALFRED H. WHITE
Professor, Chemical Engineering, University of Michigan

M. C. WHITAKER
Vice Pres., American Cyanamid Co., Director, American Chemical Society

TOWER OF LIGHT SIGNALIZING CONTINUOUS PRODUCTION OF DUPRENE

WHAT RESEARCH

In the opinion of the distinguished committee of award, the outstanding chemical engineering achievement to reach fruition during the past two years has been the successful industrial development of the synthetic rubber, DuPrene, of synthetic camphor and of certain other important organic chemicals and dyestuffs. Back of these more recent and specific accomplishments lies the major achievement of the past two decades in building a great organic chemicals industry. The importance of that development from the standpoint of national security, economic independence, and the public welfare needs no repetition to the readers of these pages. But let us here consider these ventures from the practical points of view of the chemical engineer and business man. Unless industrial development can be organized and carried on at a profit that will assure an eventual return to those who have furnished the capital to make such ventures possible, nothing of lasting value can be achieved. The development of DuPrene is a case in point.

A CHIEVEMENT as the result of group effort on the part of a corporate organization is the basis for this story. It is a remarkable record of coöperation and teamwork in a great program of industrial development that affects the lives and work of millions of Americans. In short, it is the creation in this country of a vital industry that supplies essential organic chemicals on which nearly every other industry of the world is becoming increasingly dependent. "Better things, for better living, through chemistry" is something more than a catchy slogan of E. I. duPont de Nemours & Co. It is a business creed that has molded and guided the work of thousands of chemists, engineers and industrialists.

To assign major credit for the duPont achievement to any individual or groups within the entire organization would be patently unfair. Each and all—research, engineering, production, sales, management, and administration—have contributed. But because chemical engineering and chemical engineers have participated so broadly and effectively throughout all of the affairs of the Organic Chemicals Department of the duPont company, it is appropriate that this article should be concerned primarily with that contribution. It is one that stirs the imagination and pride of the entire chemical engineering profession.

Research on synthetic rubber was started in the Organic Chemical Department of the duPont company about ten years ago, because the duPont management had faith in the ability of its chemists to produce a synthetic rubber that would be at least equal to the natural product, if given sufficient time and the necessary financial support. This faith they held in spite of the fact that years of intensive research by many of the world's most distinguished chemists had so far failed to show that the chemical laboratory could equal Nature as a rubber producer.

Acetylene seemed to be the most desirable raw material because of its reactivity and its potential availability in unlimited quantities. The first step appeared to be to cause two molecules of acetylene to react so as to produce an unsaturated compound having four carbon atoms in a straight chain. This was accomplished but the process proved to be a difficult one and the yields were disappointingly low. At this point the duPont chemists learned of the work of Father J. A. Nieuwland of the University of Notre Dame, who had found a catalyst consisting essentially of a satur-

by SIDNEY D. KIRKPATRICK
EDITOR, *Chemical & Metallurgical Engineering*

CHEMICAL ENGINEERING CREATES .... ACHIEVES

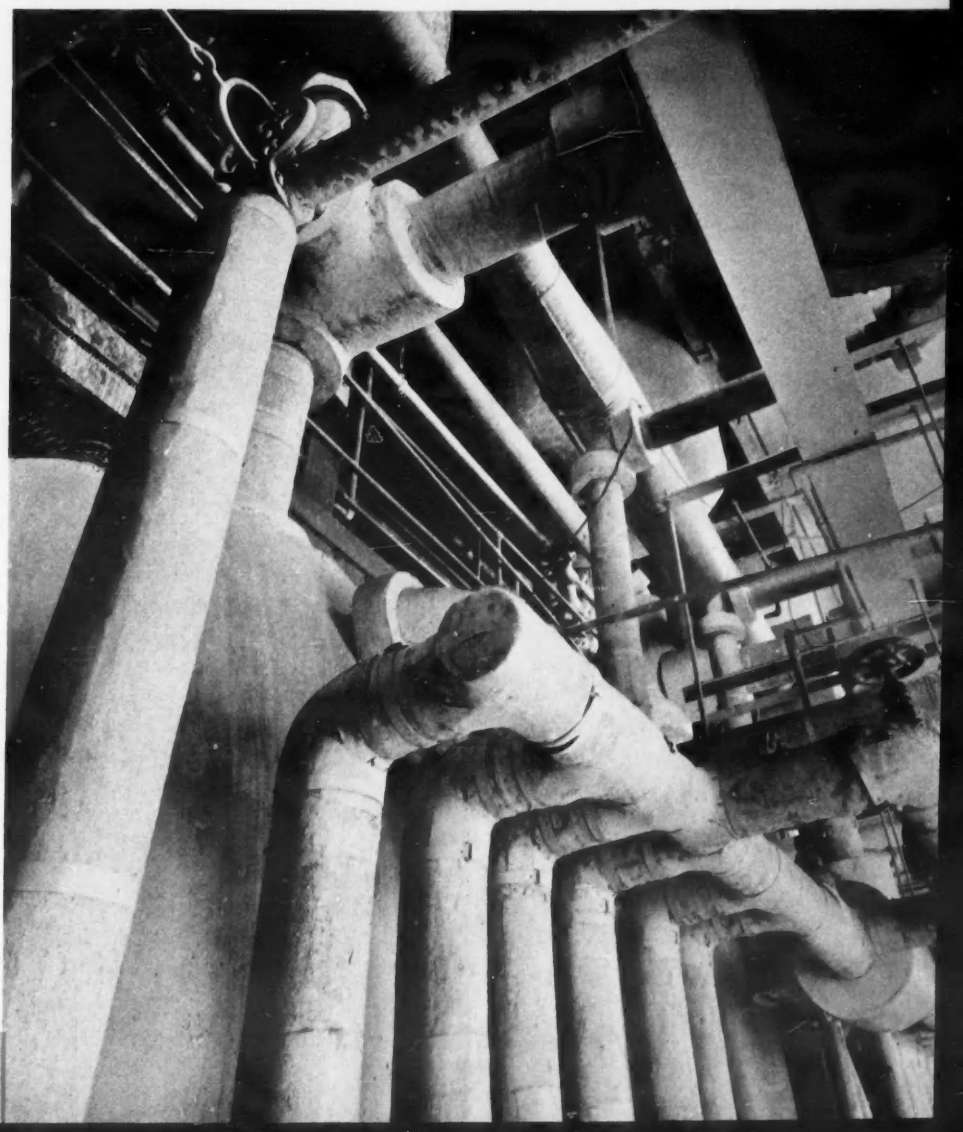
ated solution of cuprous chloride and ammonium chloride and water, with which it was possible to polymerize acetylene to divinylacetylene, an unsaturated compound having six carbon atoms in a straight chain.

It was found that the partial polymerization of this hydrocarbon produced a synthetic drying oil, "S.D.O." which, when applied on wood, metals or concrete, quickly hardens to produce a surface film that is highly resistant to practically all chemicals and solvents. Many uses for "S.D.O." have been found in the chemical and other industries, where equipment must be protected against corrosive liquids and vapors which ordinary paints, varnishes and lacquers will not resist.

Attempts to produce a satisfactory synthetic rubber by polymerizing divinylacetylene were unsuccessful, but it was soon learned that the conditions under which acetylene is exposed to the catalyst could be modified so as to produce chiefly monovinylacetylene. It did not prove to be possible to make a synthetic rubber of high quality by polymerizing monovinylacetylene but duPont research chemists further discovered that monovinylacetylene could be converted to chloroprene (chloro-2-butadiene-1, 3) by treating it with hydrogen chloride in the presence of a catalyst and that chloroprene polymerized readily to produce a synthetic rubber of very high quality.

On the promising basis of this laboratory research, the decision was made for further experimental development. This decision was of more than usual importance for a number of reasons of primary interest to the chemical engineer and industrialist. Ordinarily the process would have next been tried out in small-scale or semi-works equipment, before finally expanding it to plant scale operation. However, these acetylene reactions required the handling of gaseous raw materials, of relatively large volume per unit of weight, which made it necessary to install large-sized equipment in order to produce even experimental quantities.

In the operation of the catalytic process for converting acetylene to monovinylacetylene, it is



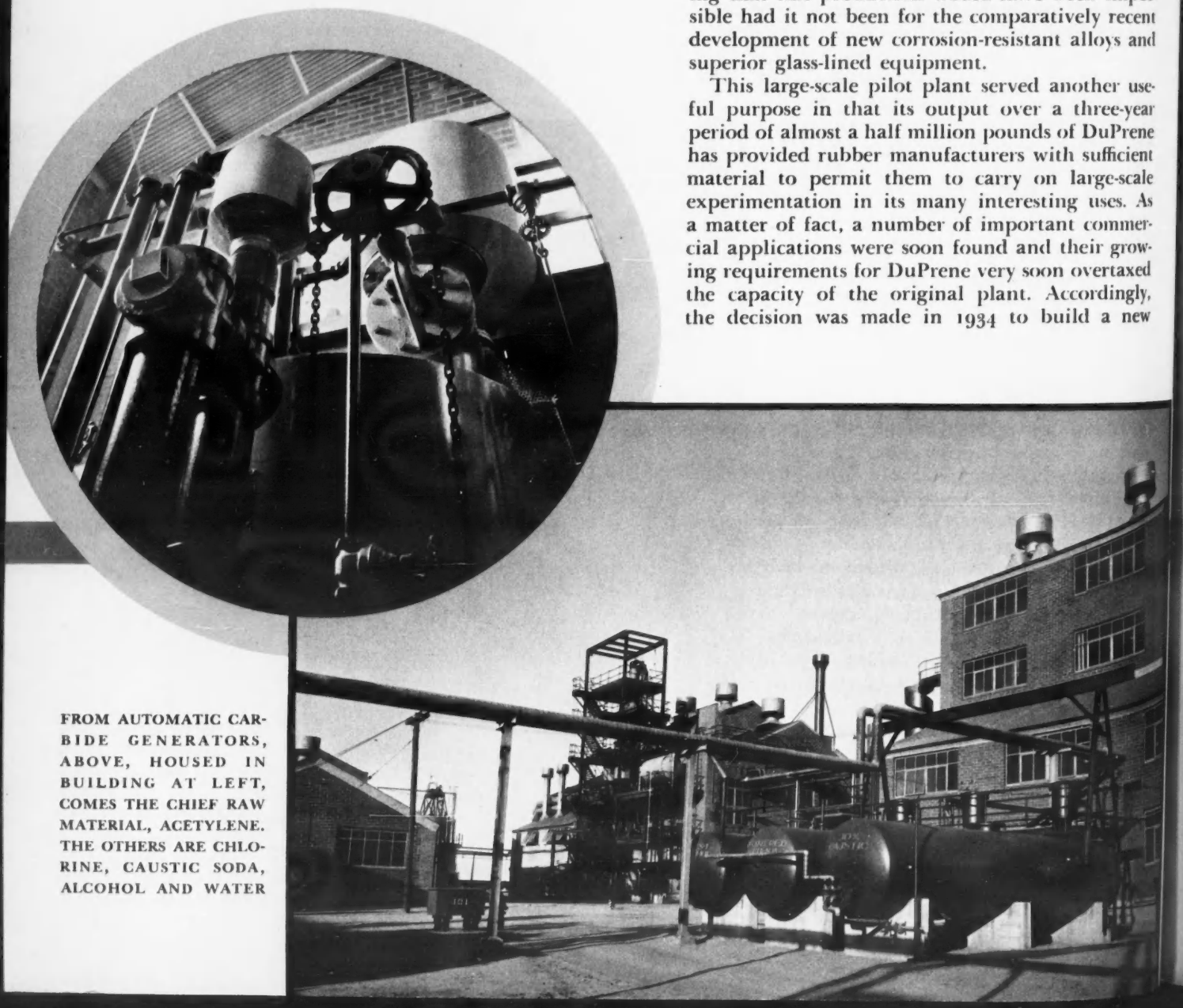
THROUGH THIS MAZE OF PIPING, ACETYLENE FINDS ITS WAY TOWARDS SYNTHETIC RUBBER

necessary that the latter product be removed from the catalyst as soon as it is formed; otherwise, the reaction will continue with the production of divinylacetylene. Accordingly, the gas is rapidly swept through the catalyst and, through condensation and fractional distillation, the monovinylacetylene is separated from the unconverted acetylene and from the divinylacetylene and other byproducts which are formed in substantial quantities, even under the most favorable operating conditions. This separation requires cooling the gas stream to about 70 degrees below zero Centigrade, which necessitated the design of a refrigeration system for which there was no precedent. Again, it was apparent that conclusive data for equipment design could only be obtained from an installation approximating large-scale production.

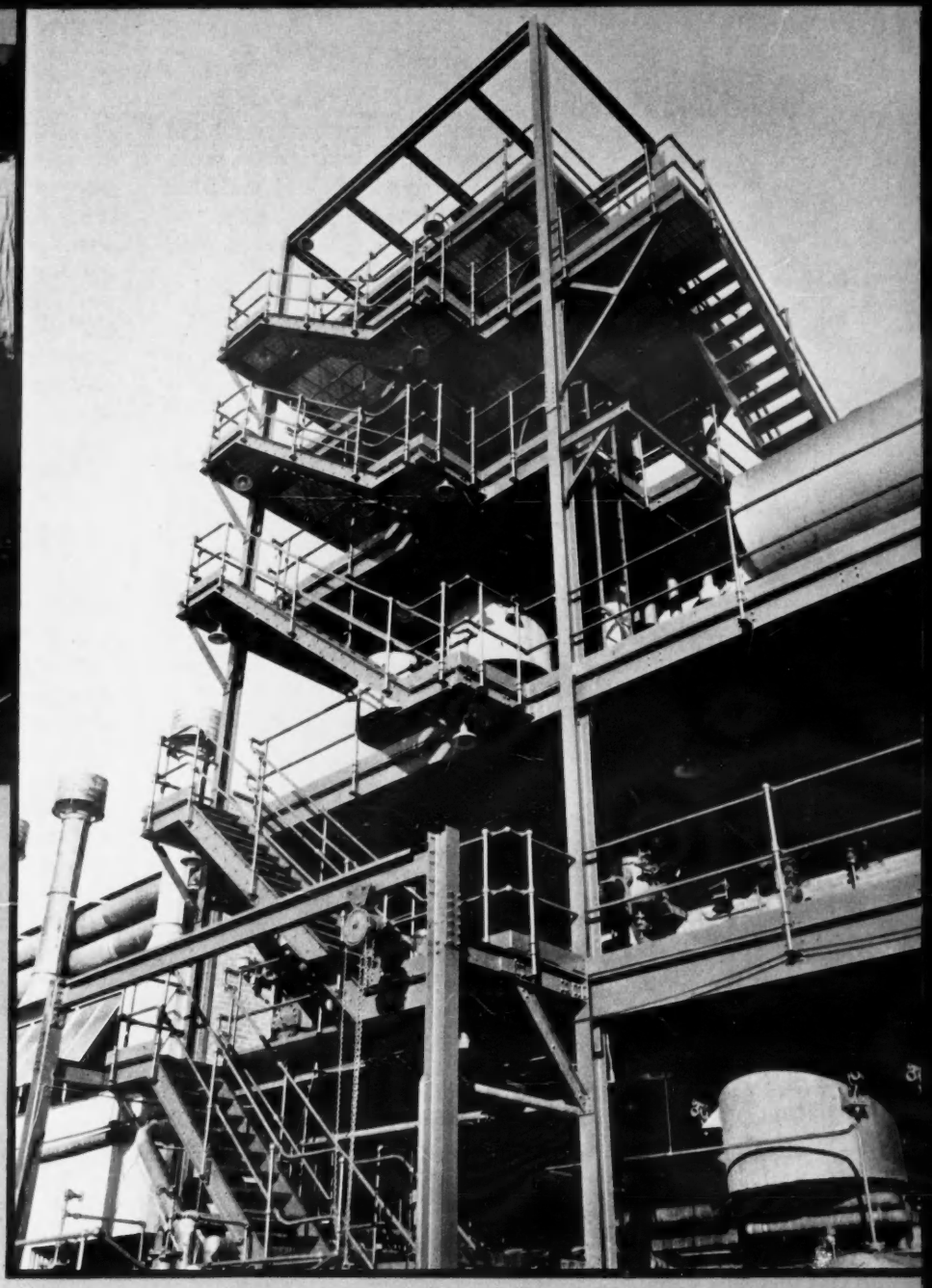
In the conversion of monovinylacetylene to chloroprene similar conditions were encountered, because chloroprene, which is formed by the addition of hydrogen chloride to monovinylacetylene, reacts readily with a second mol of HCl to form dichlorobutene. So again it was necessary to sweep the gases rapidly through the catalyst and promptly separate the reaction products. Moreover, chloroprene begins to polymerize as soon as it is formed. The polymer that accumulates in the processing equipment and pipe lines not only represents a loss of yield but makes it necessary to design the equipment so that the polymer can be removed and destroyed.

Facing these facts during the depressing days of 1931, a less courageous management might have hesitated to plunge almost directly into such a large-scale operation. Yet good chemical engineering judgment dictated that course and the pilot plant was erected. In the first three years it has served its purpose extremely well. It has been the scene of almost constant change in design and construction as many pressing problems have had to be solved through chemical research and chemical engineering development. The commercial production of synthetic rubber from acetylene would never have been possible if these problems had not been met and solved on the spot. Likewise, it is a tribute to modern chemical engineering that this production would have been impossible had it not been for the comparatively recent development of new corrosion-resistant alloys and superior glass-lined equipment.

This large-scale pilot plant served another useful purpose in that its output over a three-year period of almost a half million pounds of DuPrene has provided rubber manufacturers with sufficient material to permit them to carry on large-scale experimentation in its many interesting uses. As a matter of fact, a number of important commercial applications were soon found and their growing requirements for DuPrene very soon overtaxed the capacity of the original plant. Accordingly, the decision was made in 1934 to build a new



FROM AUTOMATIC CARBIDE GENERATORS, ABOVE, HOUSED IN BUILDING AT LEFT, COMES THE CHIEF RAW MATERIAL, ACETYLENE. THE OTHERS ARE CHLORINE, CAUSTIC SODA, ALCOHOL AND WATER



TO MAKE ALMOST A HUNDRED THOUSAND POUNDS A MONTH OF SOLID RUBBER REQUIRES THE HANDLING OF VAST QUANTITIES OF GASEOUS RAW MATERIALS OF RELATIVELY LARGE VOLUME PER UNIT OF WEIGHT

plant, which is now in commercial production. This new plant is now producing at the rate of approximately 1,000,000 pounds per year of synthetic rubber.

The value of this outstanding achievement can best be measured by comparing the properties of DuPrene with those of natural rubber. Of all the differences between DuPrene and natural rubber, the one that is most striking to the layman is its greatly improved resistance to the deteriorating effect of crude oil, refined petroleum products, coal-tar solvents, animal and vegetable oils and the other oily materials which cause natural rubber to swell and disintegrate. As a result of its oil resistance, the new product has found important applications in the manufacture of gaskets, packings, valve diaphragms, pump pistons and sealing rings. For the same reasons it is used as the lining of hose for conveying all types of oils and solvents used in the industries.

Although the oil resistance of DuPrene may be its most striking property from a layman's point of view, the fact that it withstands heat better than natural rubber appears to be of greater commercial importance. Because of this property, it is used in power transmission belts, steam packing, spinning discs for glass blowing, and many other articles which require a tough, resilient rubbery material that is less affected by heat and less inflammable than is the case with the natural product.

Every one knows that rubber tends to check or develop cracks when exposed to sunlight or when repeatedly flexed, even in the absence of sunlight. The synthetic product is greatly superior to rubber in these respects, which again opens many uses to it. Likewise, its resistance to acids and alkalis makes it useful in the construction of chemical equipment and for the manufacture of gloves and aprons to protect workmen who must handle chemicals that are destructive to rubber and

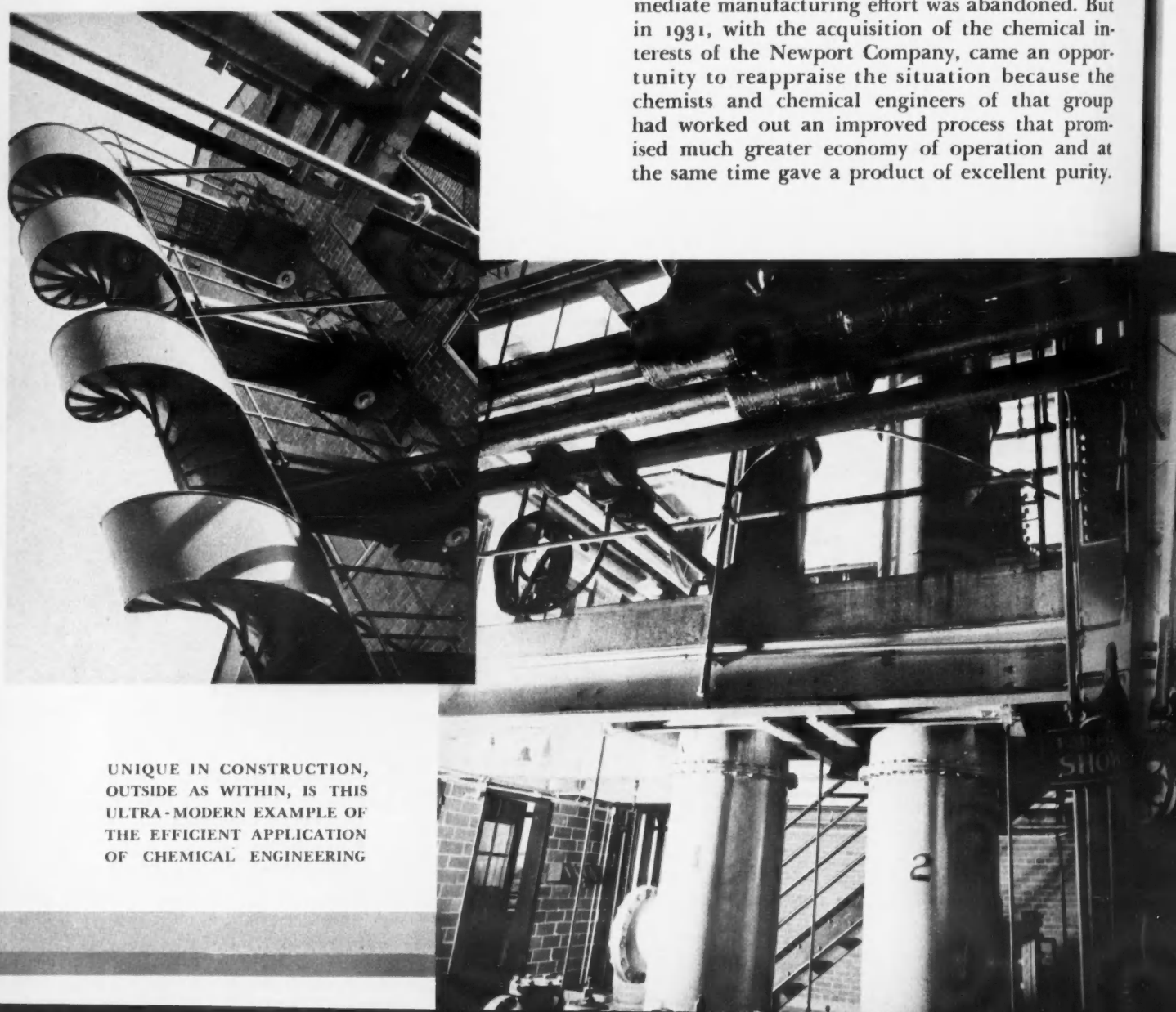
to the human skin. Many other applications could be cited but these are more than sufficient to prove the point, namely, that if research and chemical engineering development can create a new and superior material, there is a preferential market waiting for it, even at a higher price.

SYNTHETIC CAMPHOR FROM TURPENTINE

Behind synthetic camphor is an even more interesting story of years of research and development, finally culminating in successful large-scale production from American turpentine. Few industrial fields have proved more attractive for organic chemical research. Raw material has always been available in abundance. The largest market in the world for the finished product is within our borders. The only source of supply of the natural product is the island of Formosa. It is not surprising, therefore, that there should have been a number of attempts to synthesize camphor in this country. The surprise is that it has not been done successfully prior to the duPont achievement.

As much as $3,000,000 had probably been spent by various American companies in research and large scale development on synthetic camphor prior to the building of the present plant. European processes have been tried out in this country, but without success, presumably because they were dependent upon a large amount of labor and manual control. The fundamental chemistry of synthetic camphor from pinene had been fairly well worked out over the past three decades, but again the problem lay in translating laboratory processes into manufacturing methods adapted to American conditions.

In 1918 and 1920, at a time when the price of natural camphor had risen from 40 cents to $1.36 a pound, the duPont company was encouraged to enter the manufacture of a synthetic product. A plant was built at the Deepwater (N.J.) dye works to apply a process not greatly different from that used today. As first worked out, that process had some shortcomings both in the high cost of operation and the impure quality of finished products. These might well have been overcome, however, but the price of imported natural camphor fell from $1.36 a pound in 1920 to $0.59 in 1921 so that the immediate manufacturing effort was abandoned. But in 1931, with the acquisition of the chemical interests of the Newport Company, came an opportunity to reappraise the situation because the chemists and chemical engineers of that group had worked out an improved process that promised much greater economy of operation and at the same time gave a product of excellent purity.



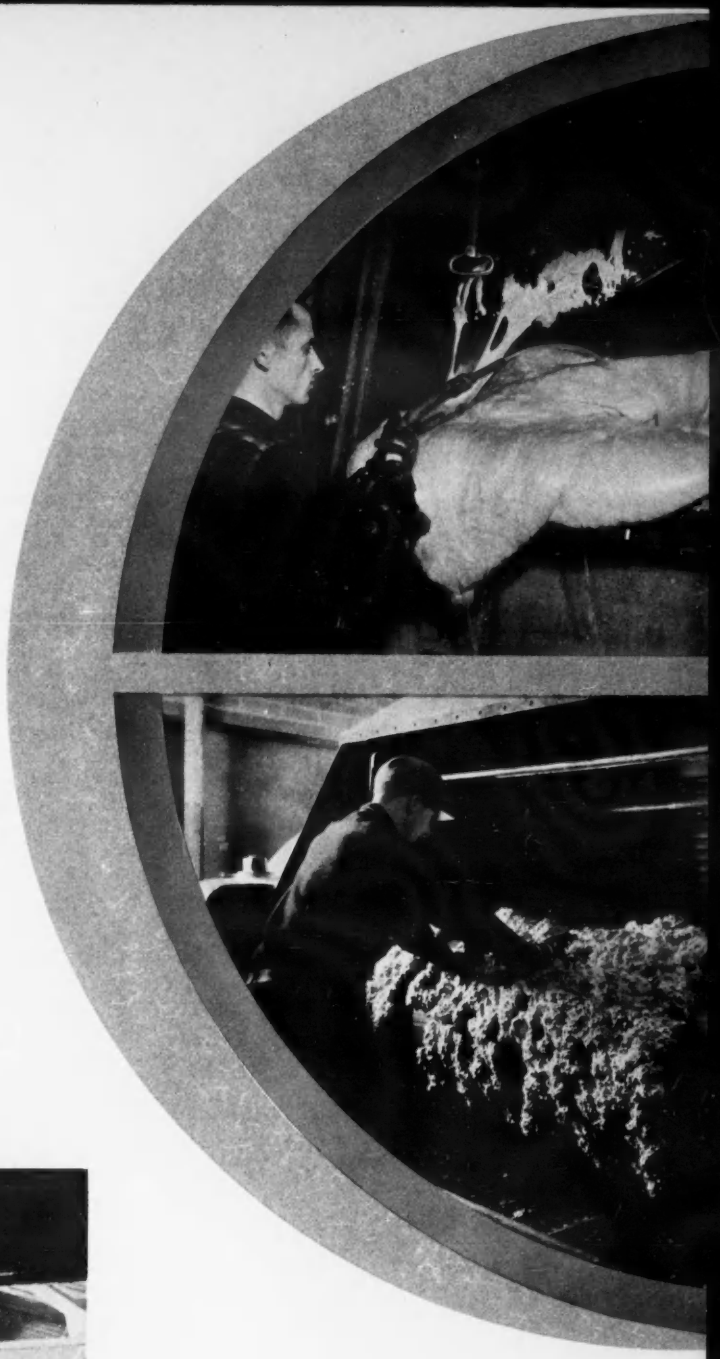
UNIQUE IN CONSTRUCTION, OUTSIDE AS WITHIN, IS THIS ULTRA-MODERN EXAMPLE OF THE EFFICIENT APPLICATION OF CHEMICAL ENGINEERING

So in 1932, again in the trough of the depression, and in spite of the fact that by this time the price of crude camphor had been reduced to $0.285, it was decided to go ahead with the construction of a large new plant at Deepwater, N. J. When completed, and in successful operation early in 1934, this new plant had an annual capacity of 1,500,000 pounds.

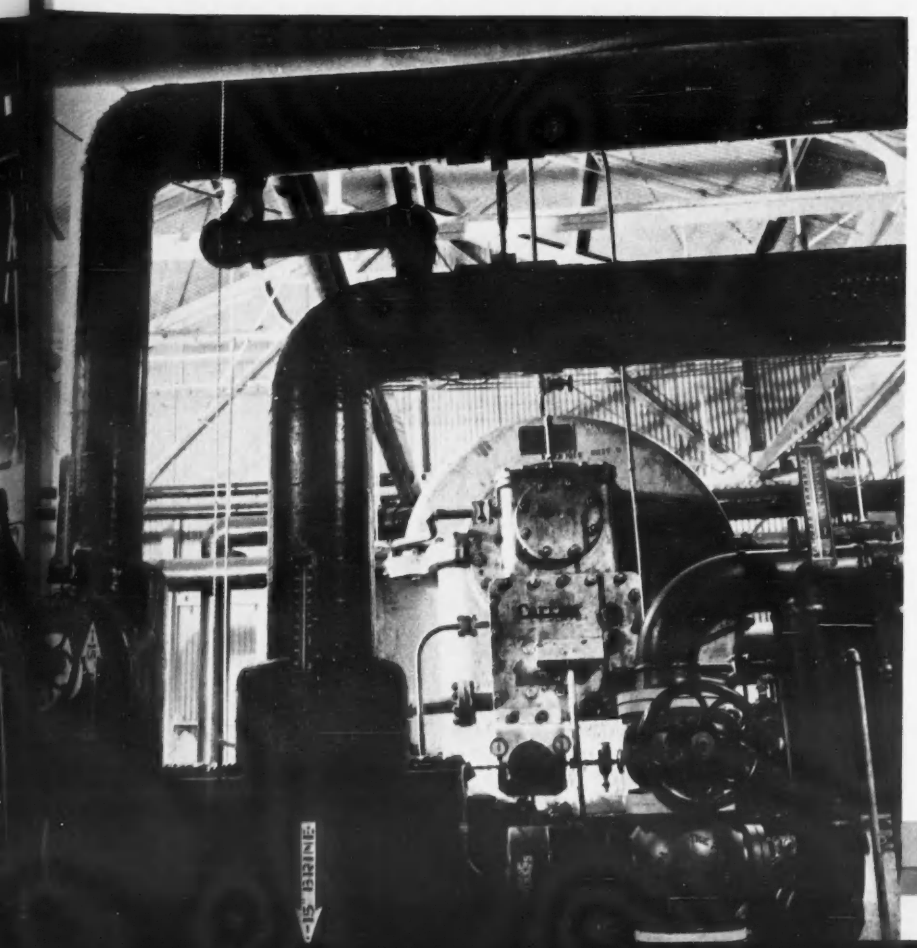
American synthetic camphor is a highly refined product, definitely superior to the synthetic material imported from abroad. The extent to which it has been accepted by American industry and is replacing the natural camphor in the manufacture of pyroxylin plastics, films, and safety glass, is now a matter of official record in Washington.

DYESTUFFS . . . PARENT INDUSTRY

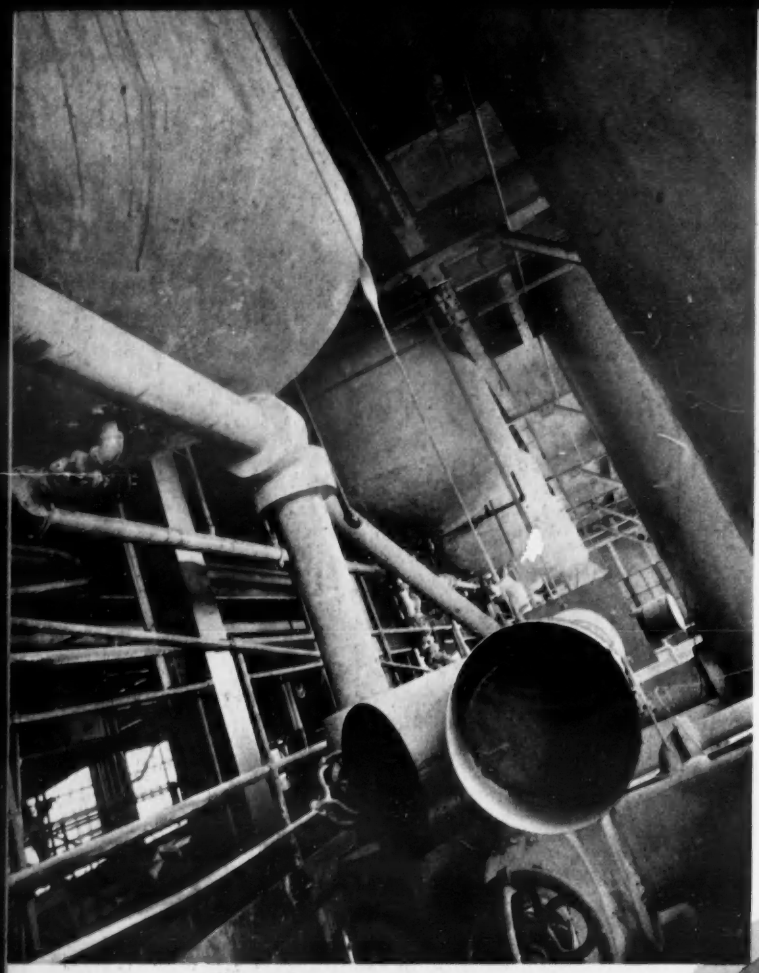
Although DuPrene and synthetic camphor well serve to dramatize the recent achievements of this resourceful and productive group, they are but typical of what has been accomplished by the Organic Chemicals Department during the past twenty years. They are in a sense the natural results of the building up of a vast fund of knowledge and experience in the solving of complicated chemical and chemical engineering problems. Today this is probably the greatest asset of the industry and the one that holds most promise for the future. It is the common bond that ties together such apparently unrelated activities as the manufacture of tetraethyl lead and dyestuffs, fluorine derivatives for refrigerants and anti-oxidants for rubber, gum inhibitors for gasoline and or-



TWO STEPS IN THE FINAL STAGES OF WASHING AND MILLING SYNTHETIC RUBBER ARE SHOWN DIRECTLY ABOVE



NOWHERE WAS THERE A PRECEDENT ON WHICH TO BASE THE DESIGN OF THIS HUGE REFRIGERATING UNIT THAT MUST DELIVER BRINE AT A SERIES OF TEMPERATURES RANGING FROM 15 TO 70 DEGREES BELOW O CENTIGRADE



FROM DOMESTIC TURPENTINE, AMERICAN CHEMICAL ENGINEERING PRODUCES . . .

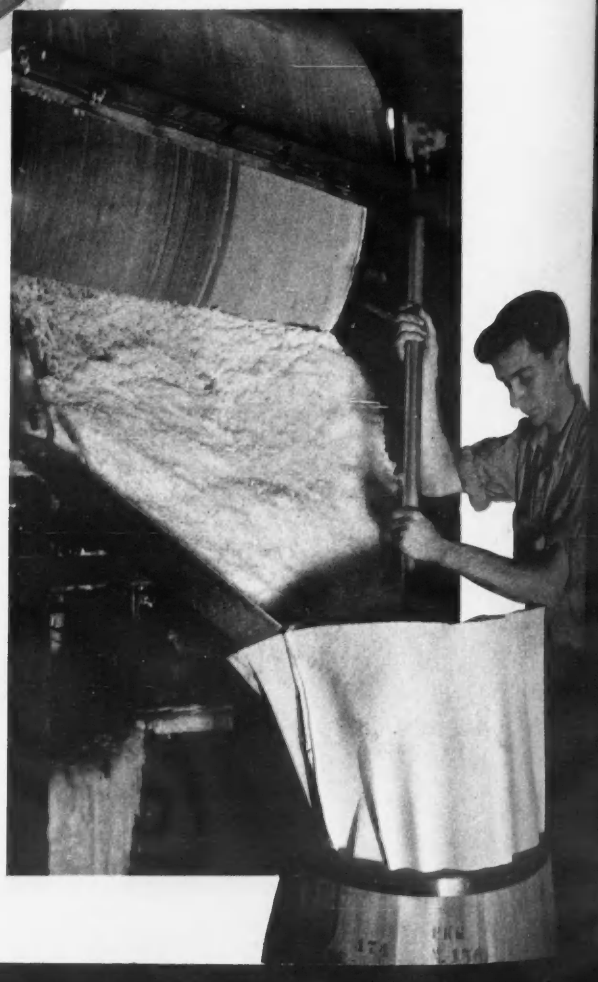
ganic mercurials for seed disinfection and the preservation of lumber. It is worth while, therefore, to look back to the origin of the parent development and briefly to trace its progress during the past twenty years of steady growth.

As long ago as 1907 the duPont company had been engaged in the manufacture of organic chemicals. Nitrocellulose, nitroglycerine, dinitrotoluol and later, trinitrotoluol, were well established products of the high explosives industry long before the World War. Diphenylamine, used as a stabilizer for smokeless powder, was among the first synthetic organic chemicals to be made by this industry. With the beginning of the World War, picric acid assumed greater importance and duPont chemists turned their attention to other chlorbenzol derivatives. From this work came the production of sulphur black, the first dyestuff to be made at Deepwater Point almost exactly twenty years ago.

The German blockade shortly thereafter resulted in urgent demands that led to the formation in 1917 of the Dyestuffs Department of the duPont company. With the acquisition of the chemical business of the Newport Company in August, 1931, the name was changed to the Organic Chemicals Department and it now includes the duPont interests in the Bayer-Semesan Company, organized in 1928, the Kinetic Chemicals, Inc., organized in 1930 and the Eastern Alcohol Company which was merged into the department in 1934.

To trace the history of the hundreds of chemical products that have come from this department during the past two decades is obviously impossible here. Dyestuffs have grown in greatest profusion but the pattern in that growth is now becoming more and more apparent. There have been improvements in quality and fastness of color as the demand has come for better methods of textile finishing. From a chemical engineering viewpoint, it is significant that in the past 15 years the average sales price of dyestuffs of domestic production has gradually declined from over $1 a pound in 1920 to a level of about 45 cents in 1935.

Anti-oxidants and accelerators for rubber, gum inhibitors, stabilizers, and oil-soluble dyes for petroleum, solvents for lacquers and plastics, plasticizers, newer textile chemicals, wetting-out agents, and the newer "soapless detergents" (long-chain alkyl sulphates)—all these and many more materials are part of the daily production of the Organic Chemicals Department of E. I. duPont de Nemours & Co. It may be truthfully said that no other industry contributes such a variety of essential products that enter into the daily life and work of the entire nation.



. . . HIGHLY REFINED SYNTHETIC CAMPHOR WHICH IS FAST REPLACING THE FOREIGN PRODUCT